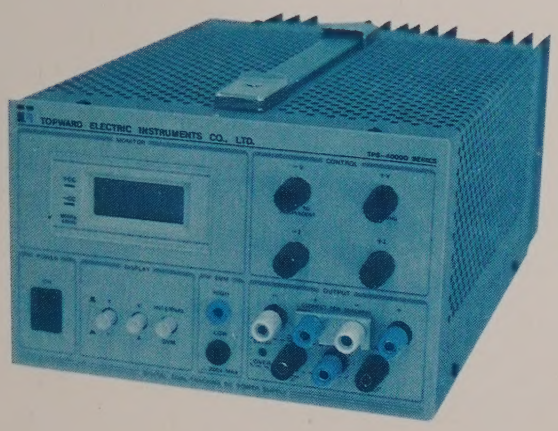
INSTRUCTION MANUAL

DIGITAL DC POWER SUPPLY

TPS-2000D/4000D Series



Topward

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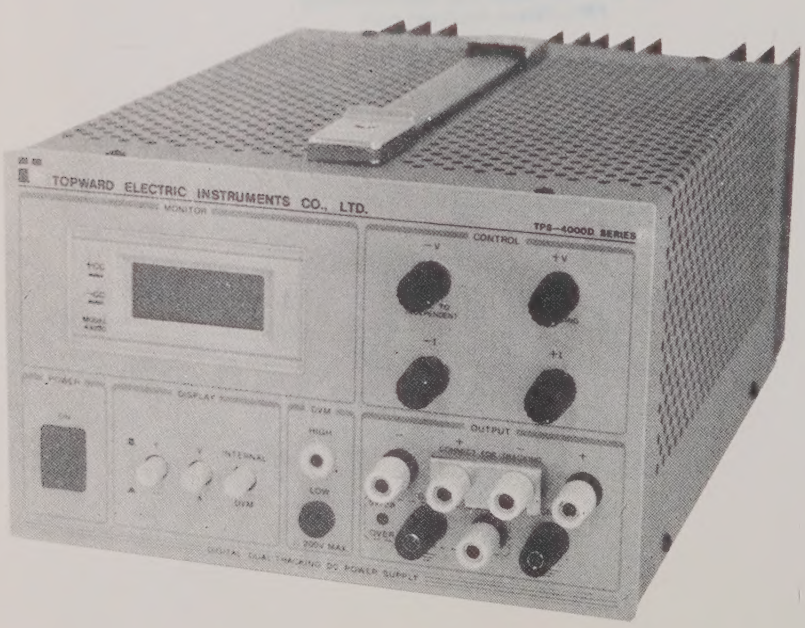
PICTURE OF MODELS TPS-2000D & 4000D

TPS-2000D Series



TPS-4000D Series

INTRODUCTION

The Topward Models TPS-2000D and 4000D series are bench top laboratory DC power supplies which incorporate a 3 1/2 digits LCD meter for monitoring voltages and currents. In monitoring mode, the LCD meter displays the output voltage in 4 automatic ranges from 199.9 mV to 199.9 V, and current in 1 fixed range of 19.99 Amps. In DVM mode, the meter displays the measured DC voltage up to 200 volts.

The models 2000D are single output, and 4000D are triple outputs supplies. The two main supplies in models 4000D can be operated in series, or tracking mode. A fixed 5V, 3A output adds versatility to models 4000D.

The models TPS-2000D, 4000D series power supplies are ideal DC power sources for use in schools, service and testing departments, engineering laboratory, even in some battery charging applications.

BEFORE WE BEGIN

The Topward Model TPS-2000D or 4000D is packed in styrofoam to protect it during shipment. You should keep this material, as well as the shipping box, in case your unit must be moved or shipped again.

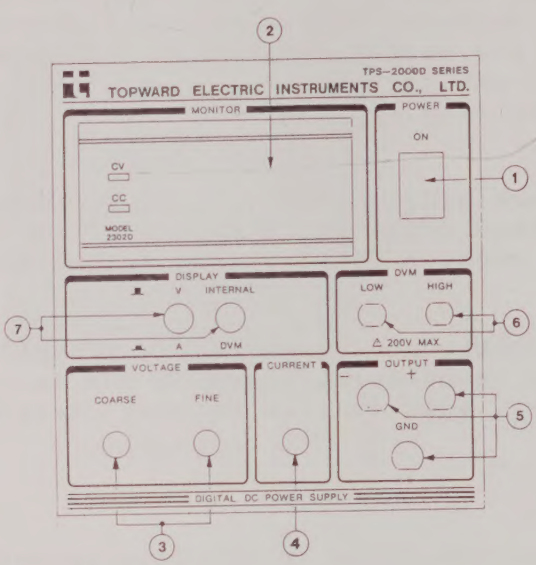
The box should contain the following items:

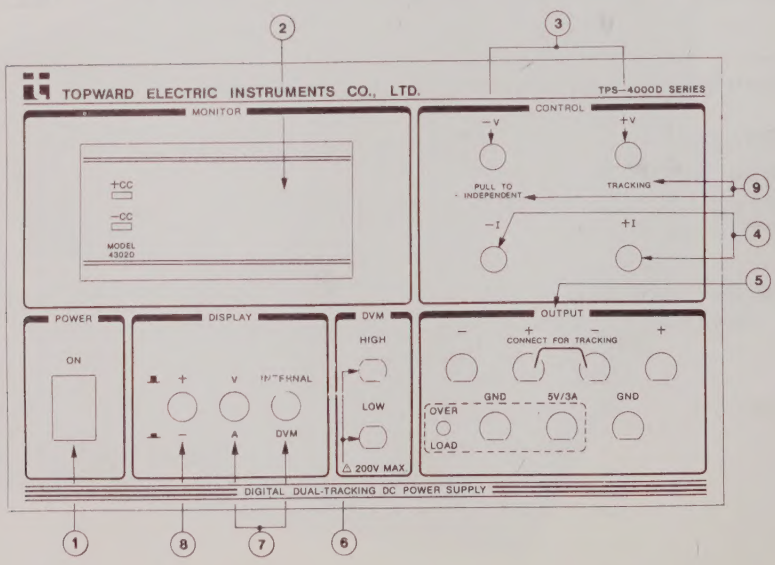
Model TPS-2000D or TPS-4000D power supply
Removeable AC line cord
Banana plug to alligator clip cable
Instruction manual

Please check to see that all of the above items are included. Contact your dealer if anything is missing.

FRONT PANEL OF MODEL TPS-2000D & 4000D Series

Figure 1





RONT PANEL DESCRIPTION

The following is an explanation of the function of each controls nd connectors. You should refer to Figure 1 for the locations.

. **POWER ON** - This is the main power switch.

. **VOLTAGE/CURRENT MONITOR** - This monitor displays the output voltage and current of the power supply, or the measured external voltage of the DVM. In addition, LED indicators for enunciating CV, CC modes.

. **VOLTAGE ADJUSTMENT** - This control sets the output voltage.

. **CURRENT ADJUSTMENT** - This control sets the output current.

. **OUTPUT TERMINALS** - These are the output terminals of the power supplies. Each supply has three color coded binding posts. In tracking mode (TPS-4000D only), the two inside connectors, one (+) and the other (-), should be shorted together using the metal strip provided. When used in other modes, the metal strip must be moved. Do not overload the 5V/3A output to more than 20 minutes in any one hour period. The GND terminal is connected to earth ground.

. **DVM INPUT** - Terminals for external DC voltage measurement up to 200 VDC maximum.

. **V/A, INTERNAL/DVM SWITCHES** - When in internal mode, the V/A switch may be selected to display either the output voltage (V) or current (A). When in DVM mode, the monitor displays the measured voltage from DVM input terminals.

. **+ / - SWITCH** - This switch selects the positive or negative output voltage or current to be displayed (TPS-4000D only).

. **TRACKING/INDEPENDENT SELECT** - When (-V) is pushed in, the main supplies are in tracking mode. The tracking voltage is controlled by (+V) knob. Although (+I) and (-I) still can be set individually. When (-V) is pulled out, the output voltages and currents are independently controlled by (+V), (-V), (+I), (-I) knobs (TPS-4000D only).

OPERATING INSTRUCTIONS

WARNING - Before connecting line power to your TPS-2000D, 4000D power supply, make sure that the AC input voltage setting (S03 and S04 in rear panel) is correct for your power source.

1. Connect the instrument to an AC power source using the line cord provided and turn the POWER switch (1) on. For maximum stability, allow the instrument to warm up at least 20 minutes.

2. Set V/A and INTERNAL/DVM switches (7) to out position. Use VOLTAGE ADJUSTMENT knob (3) to set desired output voltage. Now push V/A switch to in position and short main OUTPUT TERMINALS (5) with cable. Then use CURRENT ADJUSTMENT knob (4) to set maximum allowable output current.

3. Connect the appropriate cables to the OUTPUT TERMINALS (5) and your circuit.

4. When an unknown DC voltage needs to be measured, push INTERNAL/DVM switch (7) to in position. Connect the unknown voltage to DVM INPUT terminals (6). The result will then display on the monitor. Do not exceed 200 VDC.

5. To use the tracking mode (TPS-4000D only), short out the two inside OUTPUT TERMINALS (5) with the metal strip. Push (-V) VOLTAGE ADJUSTMENT knob (3) to in position. Set the desired tracking voltage with (+V) VOLTAGE ADJUSTMENT (3) knob. Current can be set with procedure outlined in step 2 above.

OPERATING CAUTIONS

Please observe the following cautions when operating your TPS-2000D, 4000D power supply. Failure to adhere to these procedures will damage the unit and void your warranty.

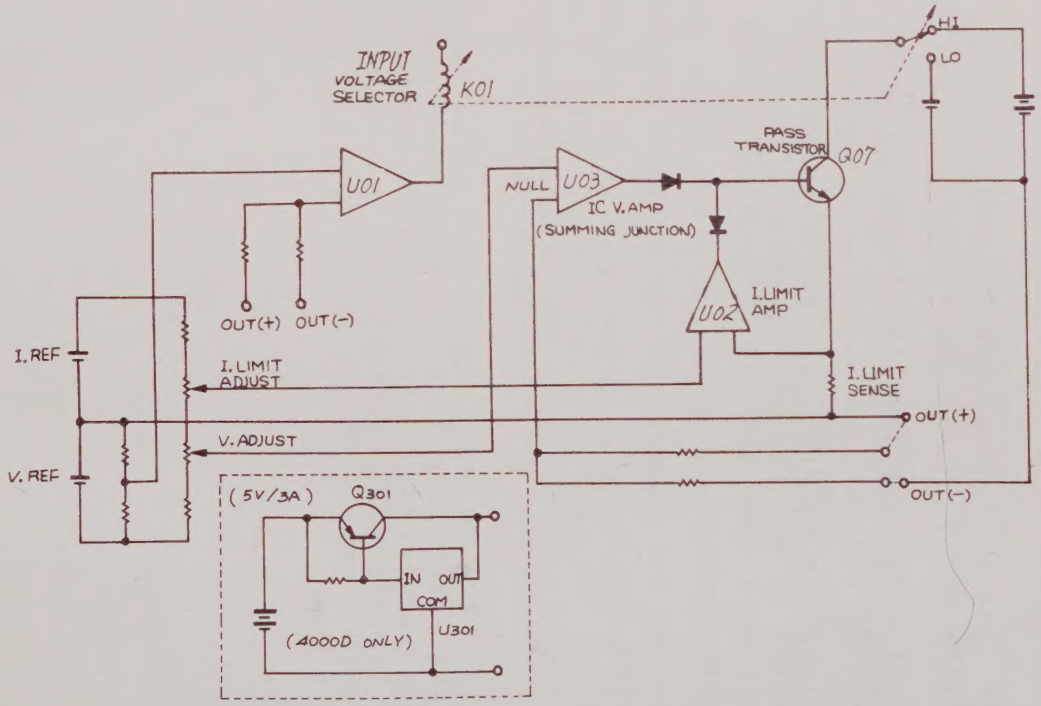
1. Verify that the AC voltage setting matches your power source BEFORE applying power to the instruments.

2. Do not connect a voltage that is greater than the set voltage at the output terminals.

3. Do not overload the 5V/3A output (TPS-4000D only) for more than 20 minutes in any one hour period.
4. Do not apply more than 200 VDC or peak AC voltage into the DVM input.

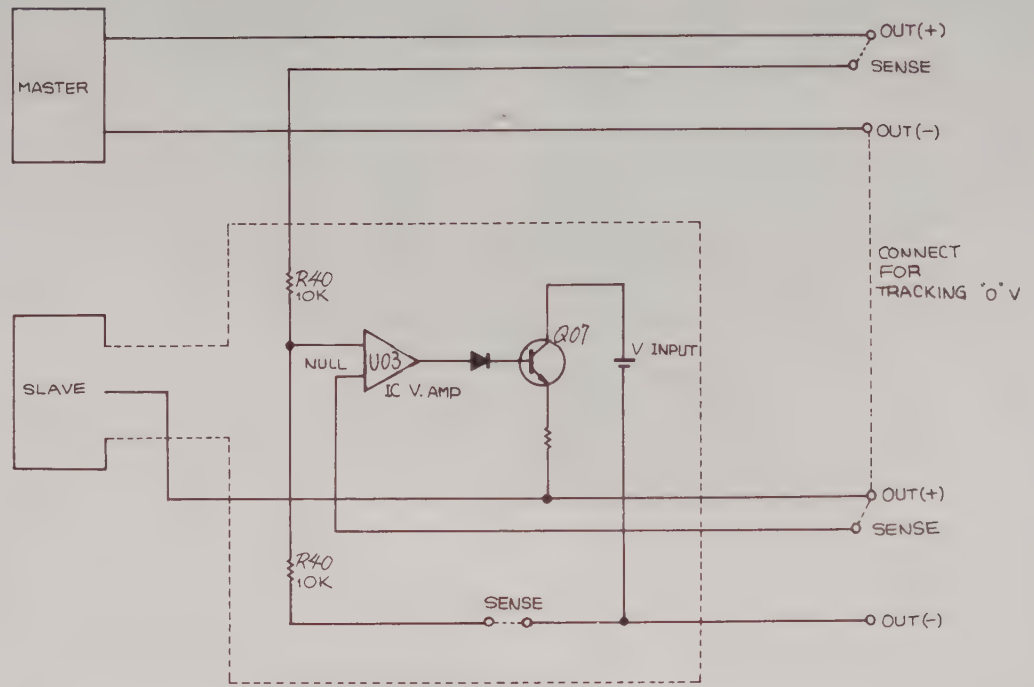
5. Do not parallel the outputs of two or more TPS-2000D or TPS-4000D supplies.

REVISION	DATE



DO NOT SCALE THIS DRAWING	TOLERANCE UNLESS SPECIFIER ARE ANGLES DECIMALS	2000D/4000D SERIES BLOCK DIAGRAM
TOPWARD ELECTRIC INSTRUMENTS CO., LTD.	DRAFTER B. O. Hyang	DRAWING NO: 82301000
	DESIGNER Simon Wang	APPROVED Simon Wang

REVISION	DATE



DO NOT SCALE THIS DRAWING

TOPWARD
ELECTRIC INSTRUMENTS CO., LTD.

TOLERANCE
UNLESS SPECIFIER ARE
ANGLES
DECIMALS

DRAFTER B. L. Huang

4000D TRACKING MODE BLOCK DIAGRAM

DRAWING NO: 82301001

DESIGNER Simon Wang

APPROVED Simon Wang

MAINTENANCE & CALIBRATION

To keep your TPS-2000D, 4000D Series power supply in top working condition, you should periodically calibrate it. As you follow the adjustment procedure below, refer to the component layout diagram for the location of the adjustment components.

1. Pull the INDEPENDENT switch (9) to INDEPENDENT mode (TPS-4000D only).

2. Turn on the unit and connect a digital multimeter (Topward Model TDM-104 or equivalent) set to the DC 200V range to the output terminals. Turn the VOLTAGE ADJUSTMENT knob (3) fully clockwise. Adjust R33 until the output is 105% of the maximum rated voltage. Repeat the above procedure for the other output (TPS-4000D only).

3. Set the multimeter to DC 20A range. Turn the VOLTAGE ADJUSTMENT knob (3) to approximately 25% of rated voltage and the CURRENT ADJUSTMENT knob (4) to fully clockwise. Adjust R32 until the output current is 105% of the rated current. Repeat the above procedure for the other output (TPS-4000D only).

4. Push the INTERNAL/DVM switch (7) in to DVM mode. Apply a +190mV into DVM INPUT (6). Adjust R412 until the MONITOR displays (2) 190.0mV ± 0.1mV. Change the input voltage to 1.9V. Adjust R404 until the MONITOR displays (2) 1.900V ± 0.001V.

5. Push V/A switch (7) in to A mode, INTERNAL/DVM switch (7) out to INTERNAL mode. Turn the CURRENT ADJUSTMENT knob (4) until the output current indicated on TDM-104 is exactly 2 amps (Model 2302D, 4302D) or 3 amps (2303D, 4303D). Adjust R34 until the MONITOR (2) indictates the same value. Repeat the above procedure for the other output (TPS-4000D only).

TROUBLESHOOTING

1. Power section for control circuit and Reference Voltage

   A. Check to be sure that line voltage select switch on rear panel is switched to correct line voltage.

   B. With power on, check CC, CV (2000D series only) LED. If there is indication of functional error, turn off power. Then check transformer and fuse on rear panel.

   C. Turn on power again and consult circuit diagram. There are two diode bridge circuits. The upper one from D01 to D04 is for the main power source. The lower one from D05 to D08 is for the control circuit and the reference voltage generator.

   D. Check the voltage of Q05, Q06 emitter with a digital multimeter (Topward Model TDM-104 or equivalent). It should read +9.6V ± 10% on Q05 and -11.5V ± 10% on Q06. The DMM GND (negative) clip must be clipped to the main positive OUTPUT TERMINAL (5).

   E. Check the voltage of CR03, CR04. It should read + 3.3V ± 10% on CR03 and -8.2V ± 10% on CR04.

2. Voltage Control Circuit

   A. Turn the VOLTAGE ADJUSTMENT knob (3) to minimum and the CURRENT ADJUSTMENT knob (4) to maximum. Check to be sure that the voltage of U03 pin 6 is within -5V and -12V.

   B. Then turn the VOLTAGE ADJUSTMENT knob (3) to maximum and check to be sure that the voltage of U03 pin 6 is +2V ± 20%.

   C. Please note that the positive voltage control current passes through Q01, Q02, and Q07.

   D. Check to be sure that the voltage display of the MONITOR (2) is controlled by VOLTAGE ADJUSTMENT knob (3).

3. **Current Control Circuit**

A. Turn the CURRENT ADJUSTMENT knob (4) to minimum. Check to be sure that the voltage of U02 pin 6 is within -5V and -9V.

B. Turn VOLTAGE ADJUSTMENT knob (3) to maximum.

C. Connect the positive OUTPUT TERMINAL (5) and the negative OUTPUT TERMINAL (5) with a 5 Ohm 50W resistor or similar component.

D. The current display of the MONITOR (2) is controlled by the CURRENT ADJUSTMENT knob (4).

4. **Relay Circuit and the CC, CV LED**

A. The U01 (relay control IC) is controlled by the main output voltage. At approximately half of the maximum output voltage, the relay will change state.

B. The CC LED is controlled by the constant current mode. The CV LED is controlled by the constant voltage mode.

5. **Tracking**

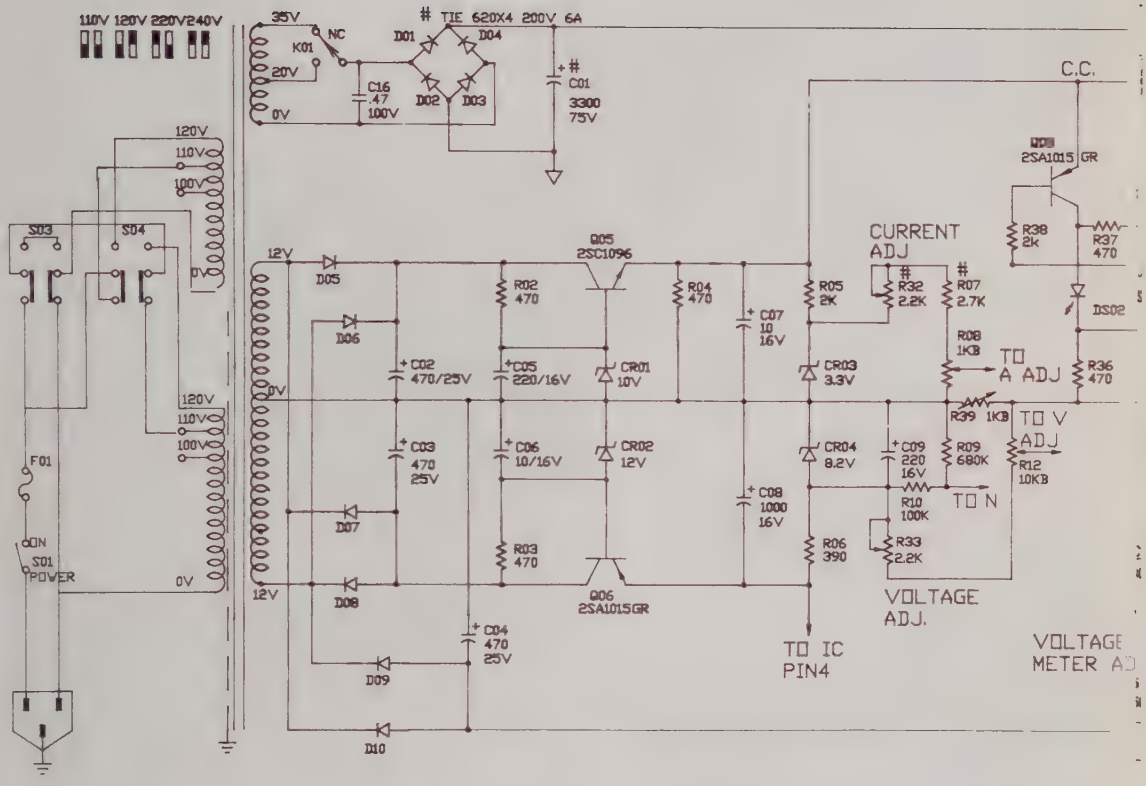
A. Push the INDEPENDENT switch (9) in to TRACKING mode.

B. The slave IC U03 is controlled by the master output voltage. The output voltage control current passes through slave transistors Q01, Q02 and Q07.

6. **Monitor**

A. Check to be sure that the voltage of U402 pin 3 is +9V ± 5%.

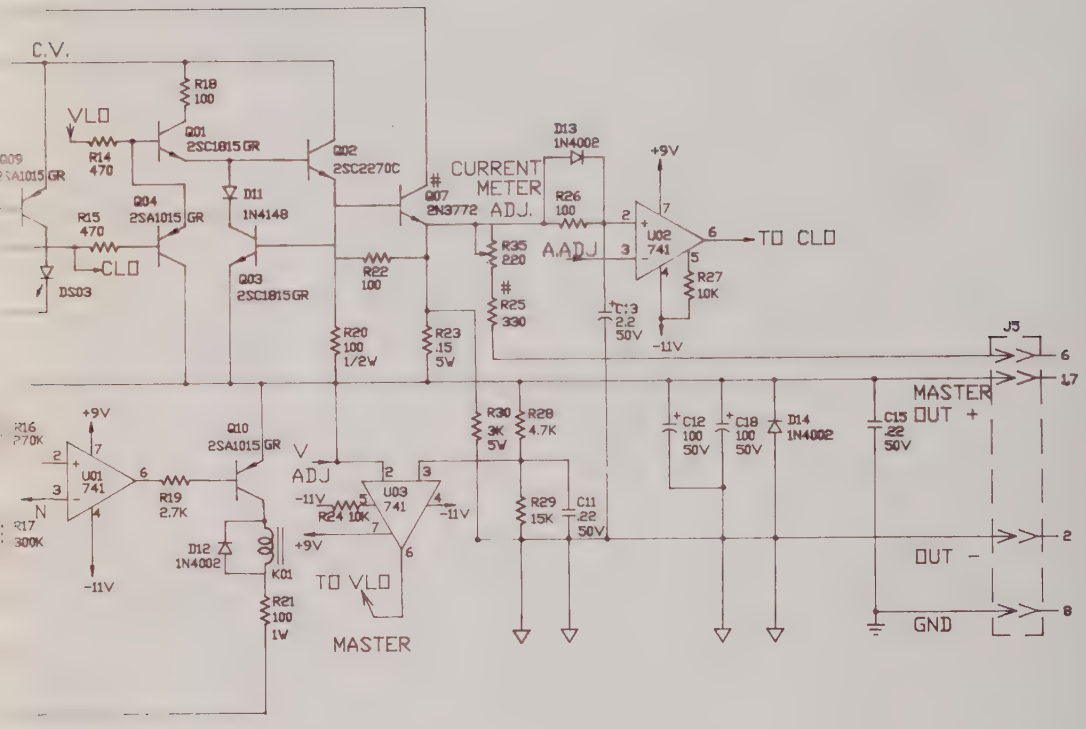
B. U401 is an 3 1/2 digit LCD DVM chip. If the display is not working, check for bad connections or defective display module.



NOTE

1. ALL RESISTOR VALUES ARE IN OHMS UNLESS OTHERWISE SPECIFIED.
2. ALL CAPACITOR VALUES ARE IN MICROFARADYS.
3. ALL VALUES OF TPS-2303D AND TPS-2302D ARE THE SAME UNLESS OTHERWISE SPECIFIED.
4. ⏚ DENOTE OUTPUT – CONNECTION.
5. ⏚ DENOTE CHASSIS CONNECTION
6. INPUT CAN BE FACTORY-MODIFIED.
7. # DENTI
   TPS-23
8. THE FO
   DIFFERE

PART
R07
R25
R32
D01~04
Q07
C01

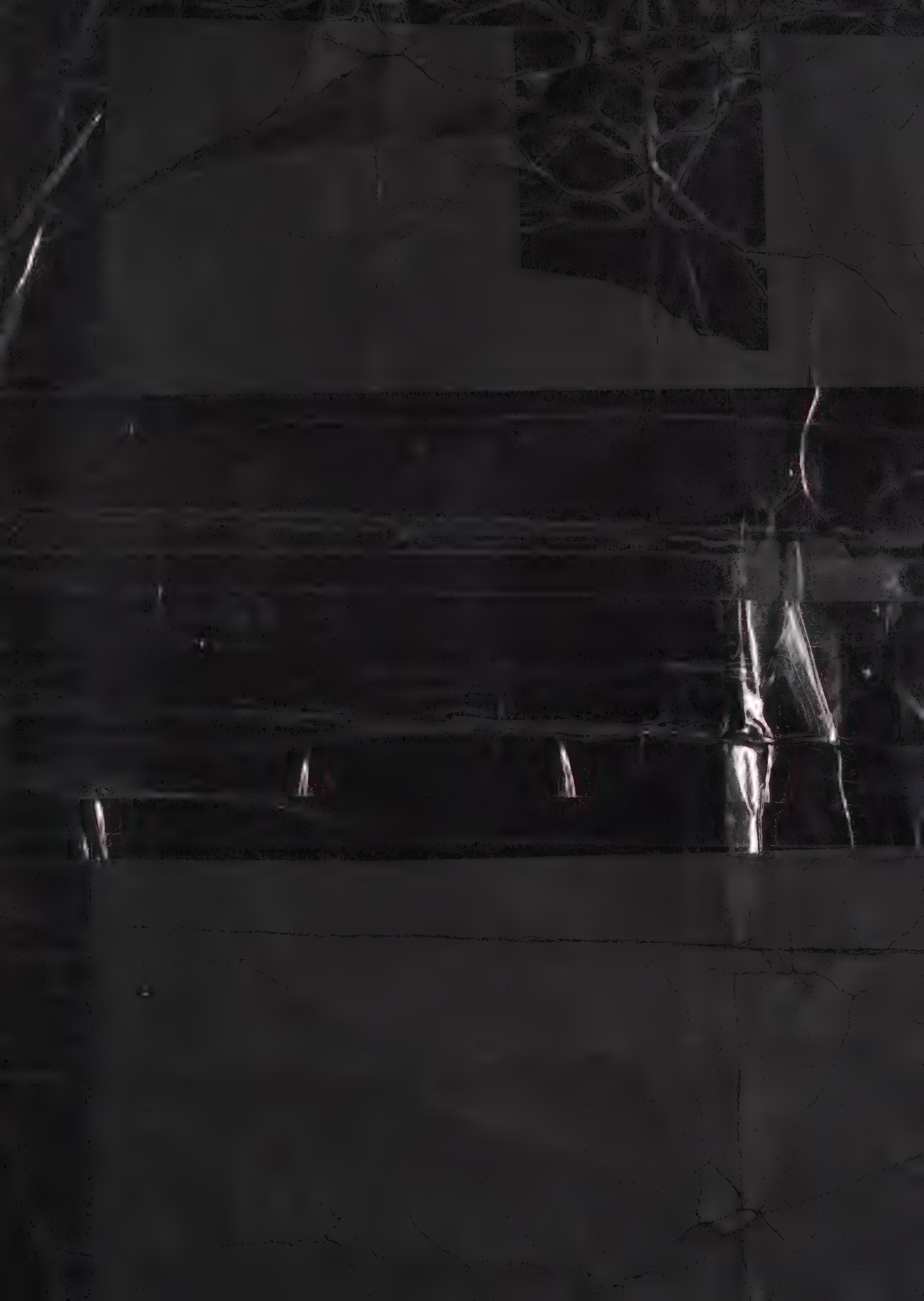


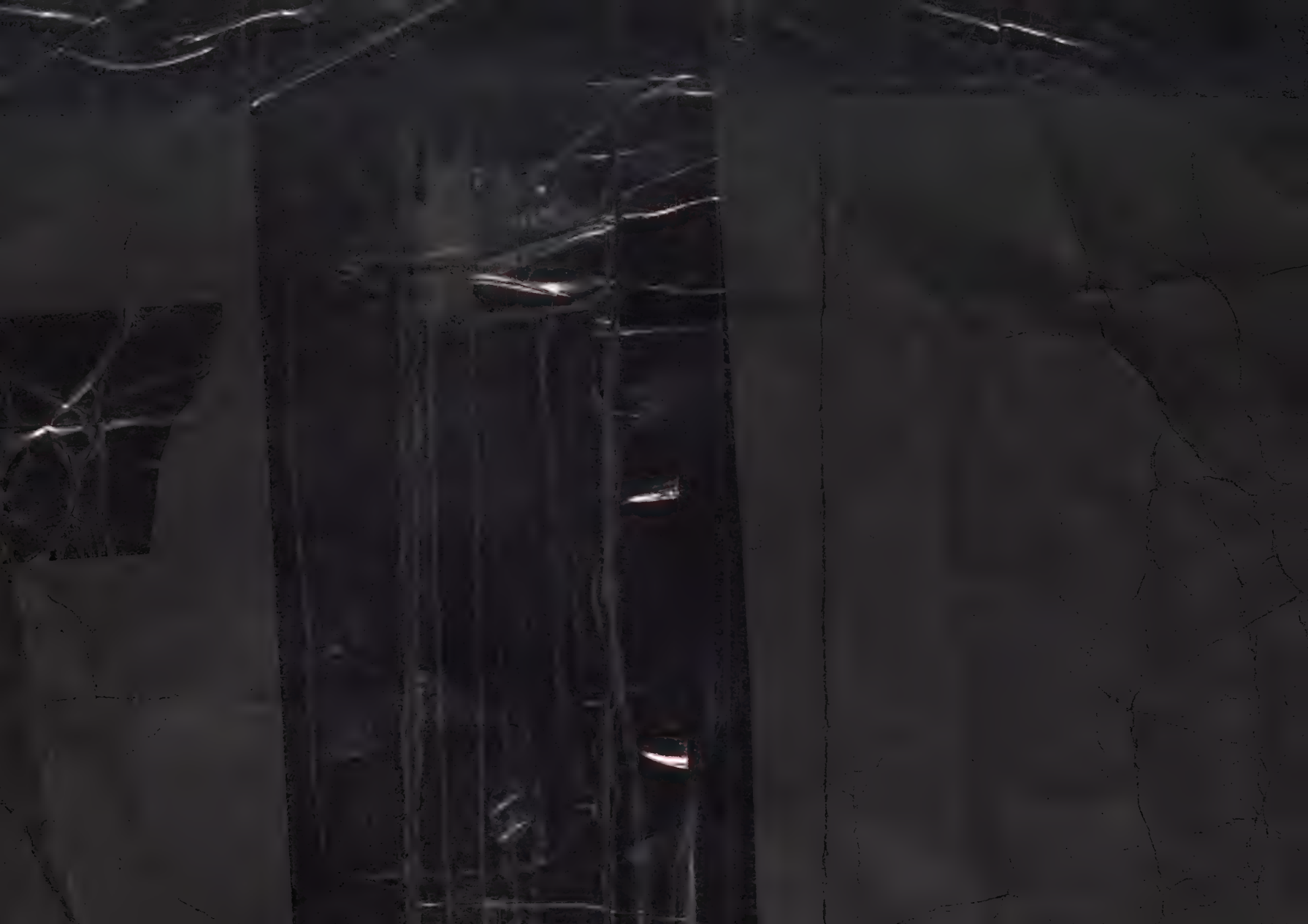
JE VALUES WHICH TPS-2303D AND
02D ARE DIFFERENT.

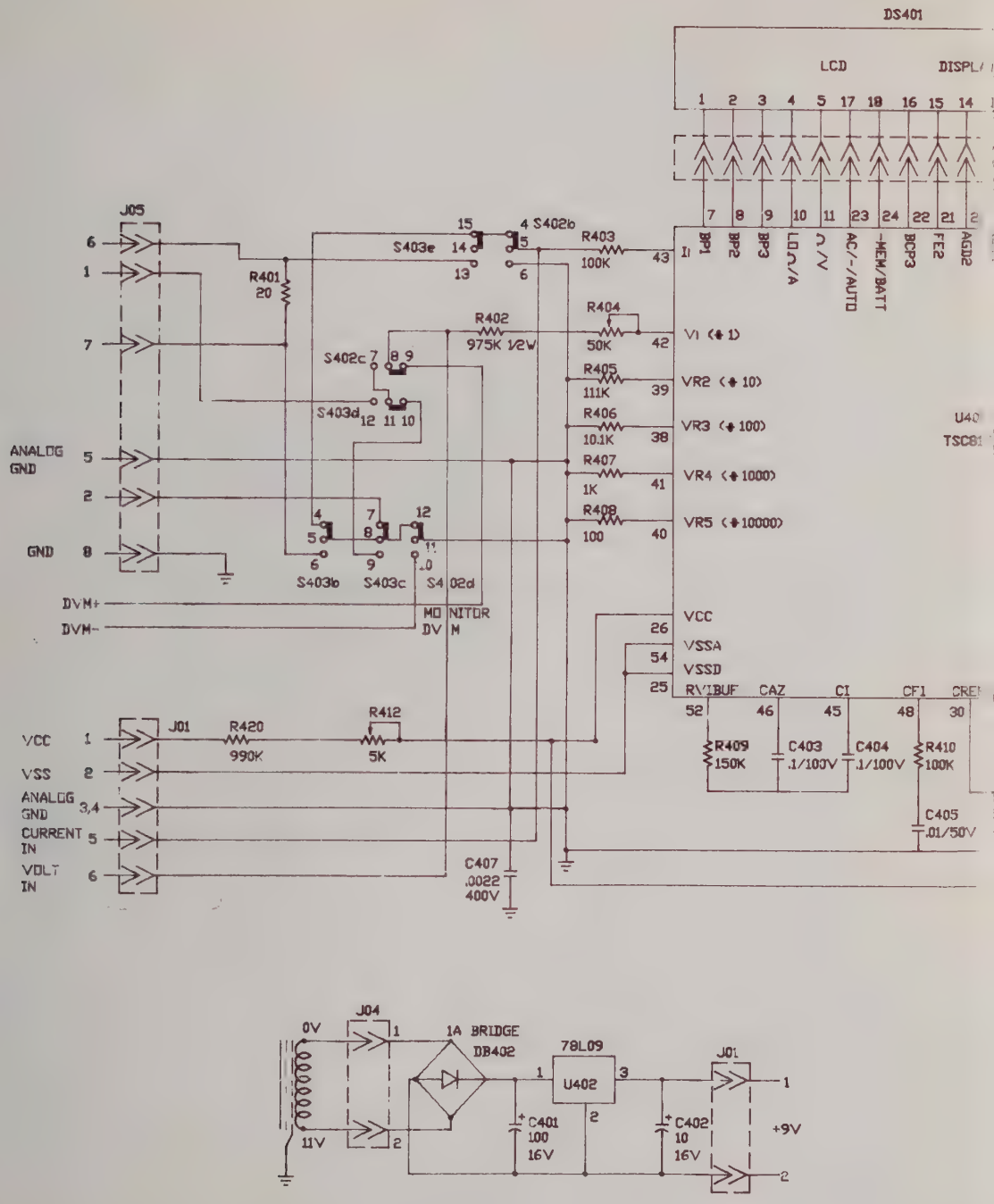
LLOWING TABLE SPECIFIES THE
NCE BETWEEN TPS-2303D AND TPS-2302D.

2302D	2303D
5.1k	2.7K
270	330
3.3k	2.2K
1N5402	TIE620
2N3055	2N3772
2200	3300

DWG No.	82001000	
DESCRIPTION	DIGITAL POWER SUPPLY (2000) CIRCUIT DIAGRAM	
DRAFTED BY	ANITA YUEN 4/5/1988	FIRST USE 2303D
DESIGNED BY		SHEET / SIZE OF / A3
APPROVED BY		



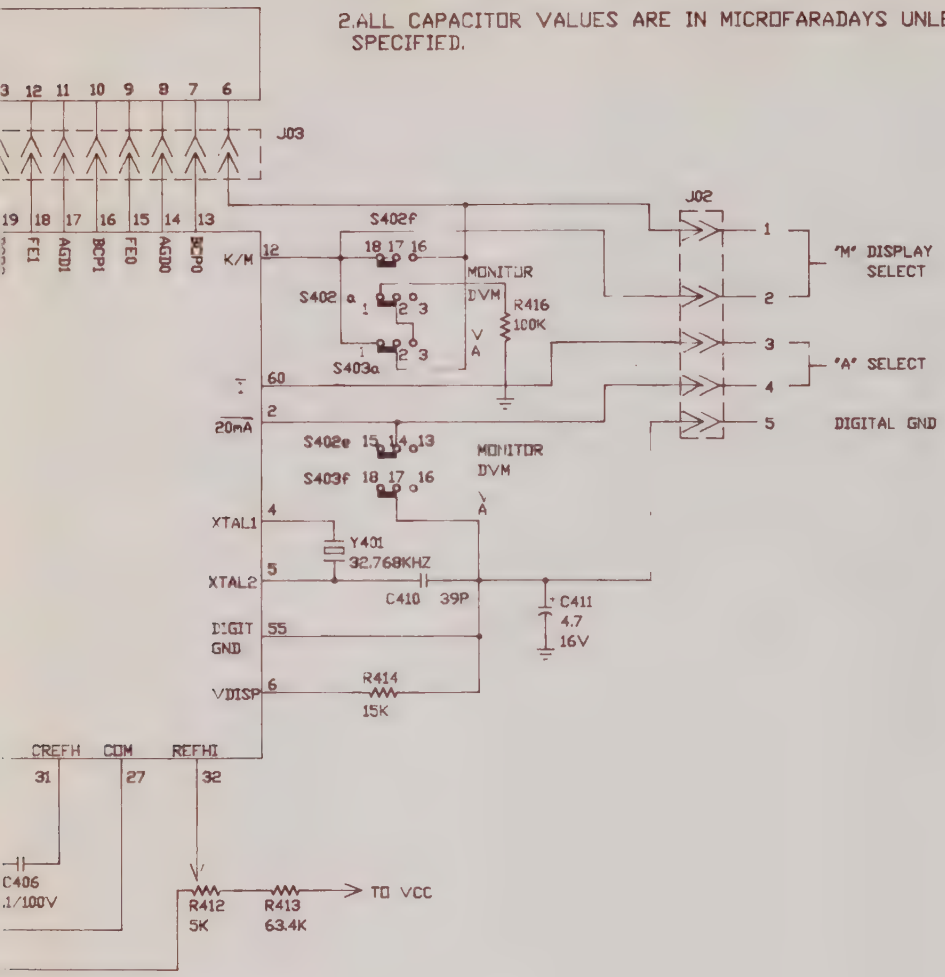



DS401
LCD
DISPL
J05
S403e
S402b
R403
100K
R401
20
R402
975K 1/2W
R404
50K
S402c
S403d
R405
111K
R406
10.1K
R407
1K
R408
100
ANALOG GND
GND
S403b
S403c
S402d
DVM+
DVM-
VCC
VSSA
VSSD
RVIBUF
CAZ
CI
CF1
R409
150K
C403
.1/100V
C404
.1/100V
R410
100K
C405
.01/50V
J01
R420
990K
R412
5K
VCC
VSS
ANALOG GND
CURRENT IN
VOLT IN
C407
.0022
400V
J04
0V
11V
1A BRIDGE
DB402
78L09
U402
C401
100
16V
C402
10
16V
+9V

NOTES

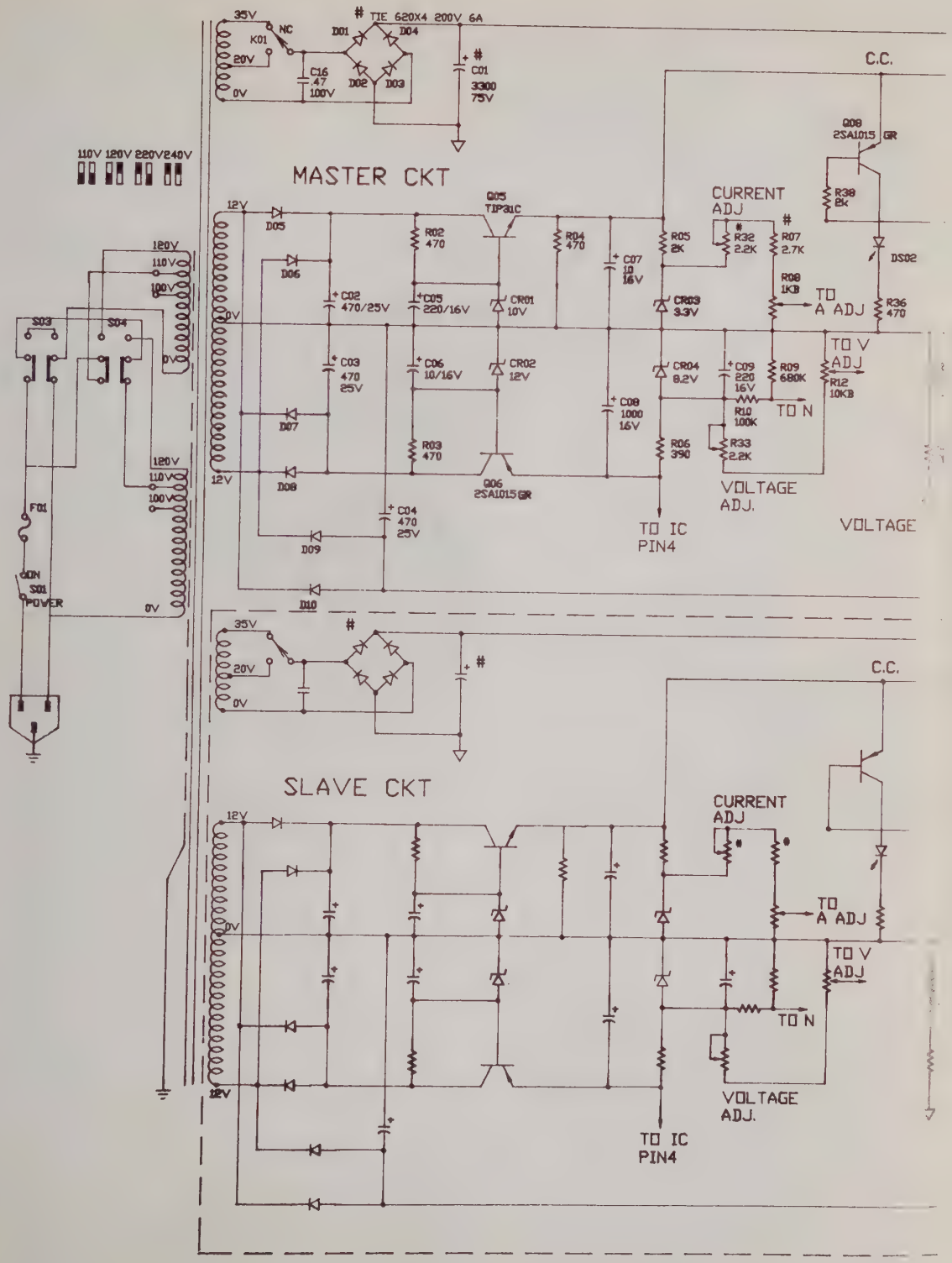
1.ALL RESISTOR VALUES ARE IN OHM UNLESS OTHERWISE SPECIFIED.
(K-KILOHMS, M-MEGAOHM)

2.ALL CAPACITOR VALUES ARE IN MICROFARADAYS UNLESS OTHERWISE SPECIFIED.



DWG No.	82001001
DESCRIPTION	DIGITAL POWER SUPPLY (2000D) CIRCUIT DIAGRAM-2
DRAFTED BY	ANITA YUEN 4/7/1988
DESIGNED BY	
APPROVED BY	

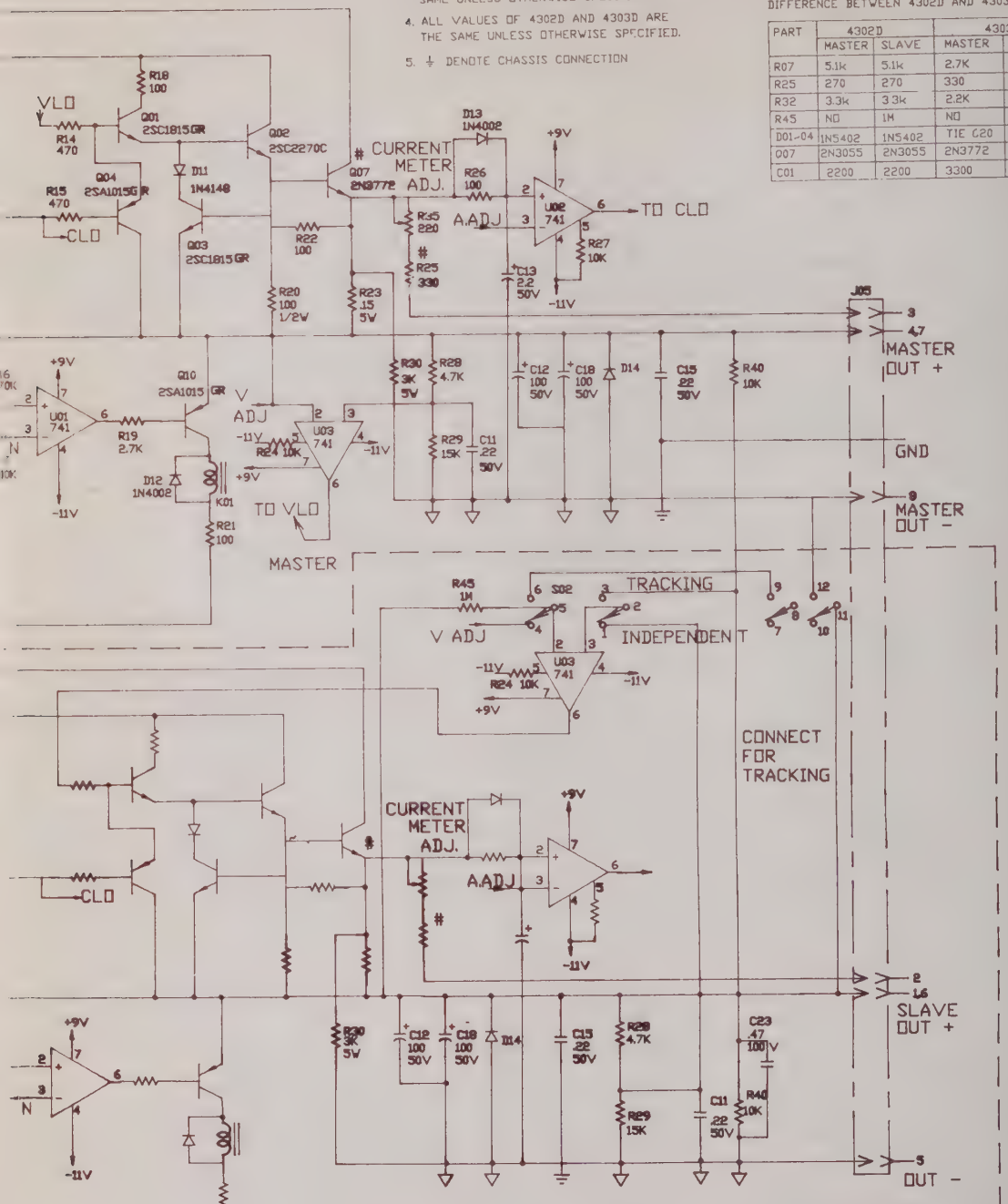
FIRST USED	
2000D	
SHEET	SIZE
1 OF 1	A3


MASTER CKT
SLAVE CKT
110V 120V 220V240V
35V
20V
0V
12V
K01
NC
D01
D02
D03
D04
TIE 620X4 200V 6A
C01 3300 75V
C16 .47 100V
C.C.
Q08 2SA1015 GR
R38 8K
CURRENT ADJ
R32 2.2K
R07 2.7K
R08 1KB
TO A ADJ
DS02
R36 470
R05 2K
CR03 3.3V
TO V ADJ
R12 10KB
R09 680K
C09 220 16V
R10 100K
TO N
R33 2.2K
VOLTAGE ADJ.
VOLTAGE
TO IC PIN4
Q05 TIP31C
R02 470
R04 470
C07 10 16V
C02 470/25V
C05 220/16V
CR01 10V
C03 470 25V
C06 10/16V
CR02 12V
C08 1000 16V
CR04 8.2V
R03 470
R06 390
Q06 2SA1015 GR
C04 470 25V
D05
D06
D07
D08
D09
D10
S03
S04
S01 POWER
FU1
120V
110V
100V
0V

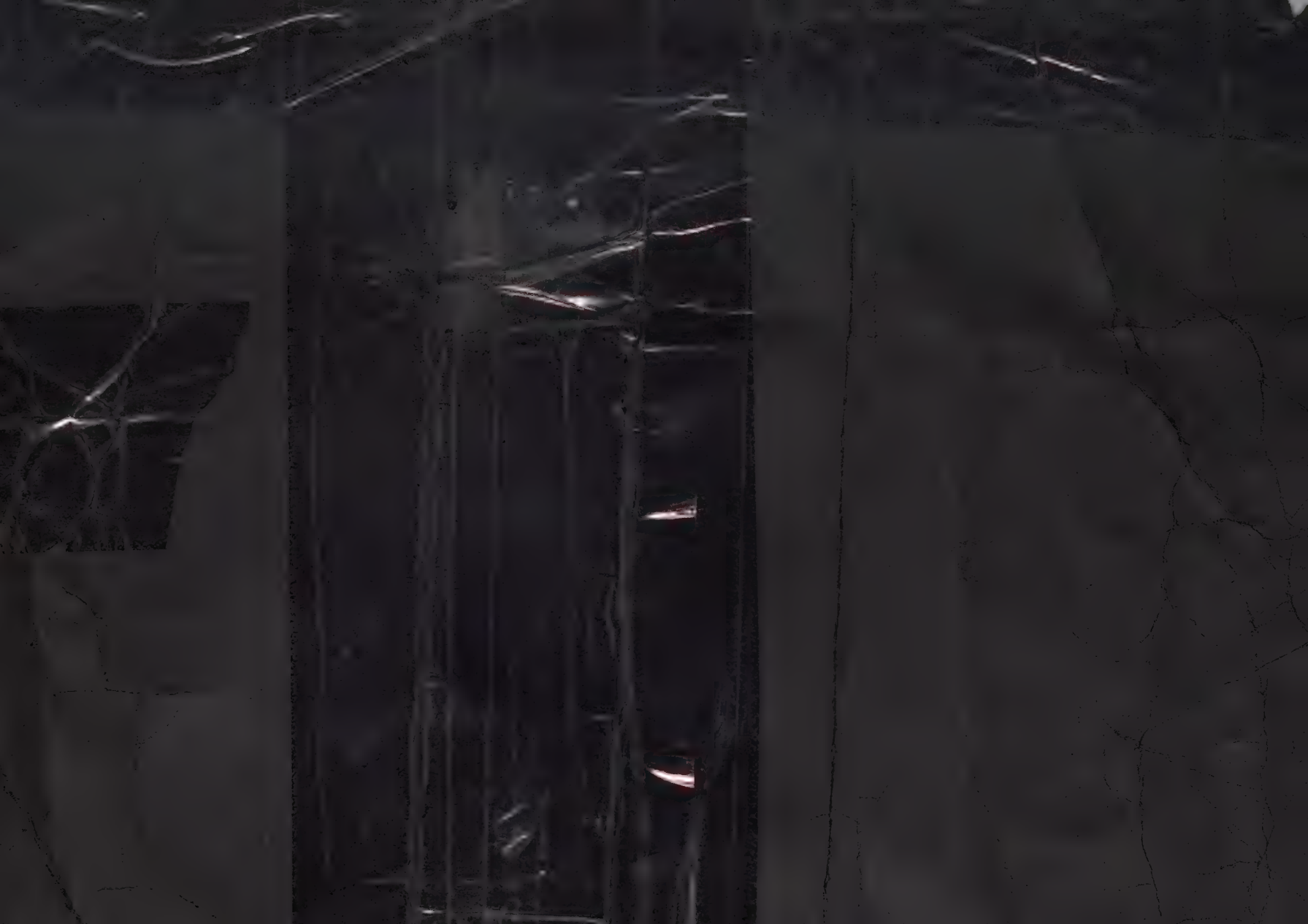
NOTES:

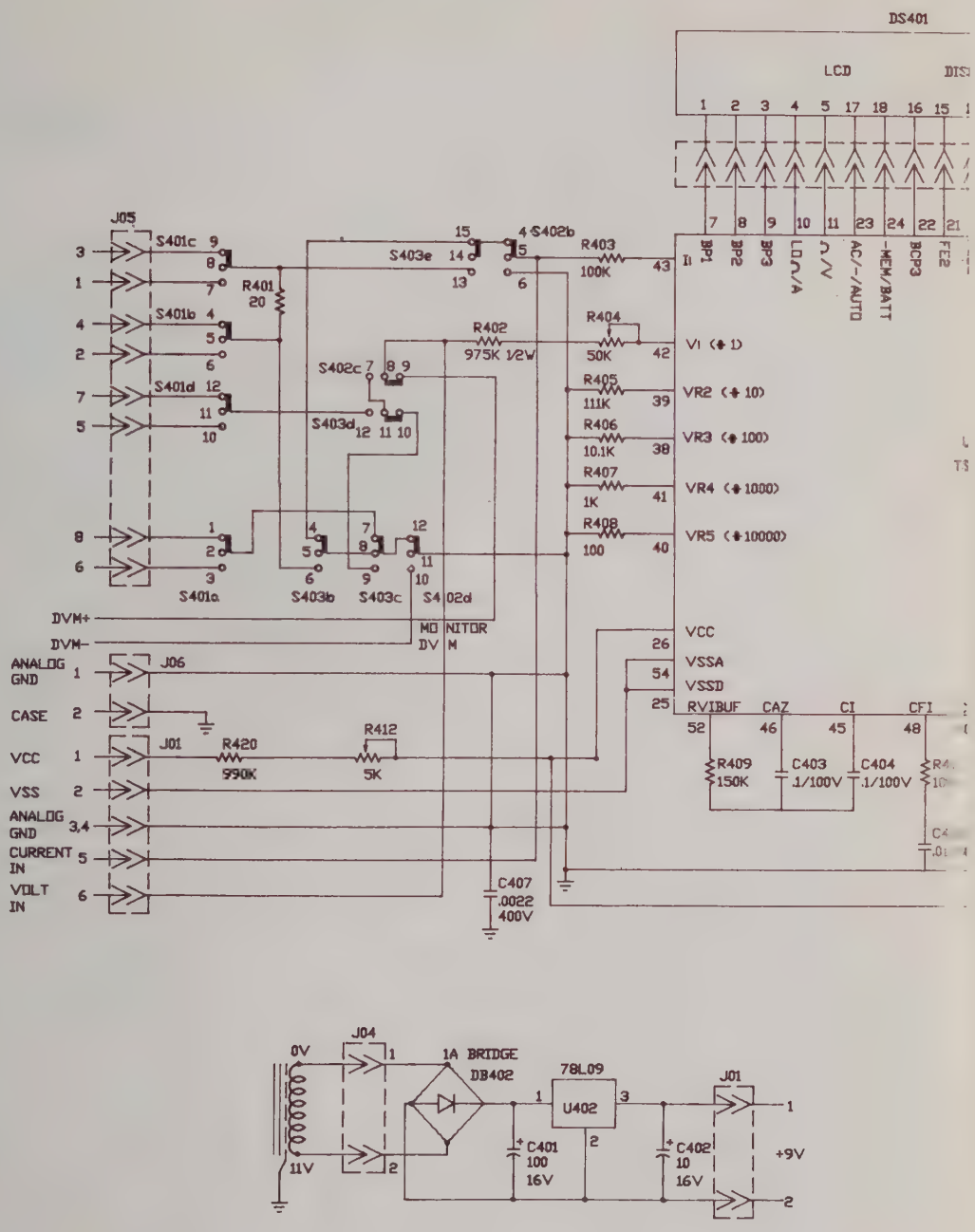
1. ALL RESISTOR VALUES ARE IN OHMS UNLESS OTHERWISE SPECIFIED.
2. ALL CAPACITOR VALUES ARE IN MICROFARADYS.
3. ALL VALUES OF MASTER AND SLAVE ARE THE SAME UNLESS OTHERWISE SPECIFIED.
4. ALL VALUES OF 4302D AND 4303D ARE THE SAME UNLESS OTHERWISE SPECIFIED.
5. ⏚ DENOTE CHASSIS CONNECTION
6. ⏚ DENOTE OUTPUT - CONNECTION
7. # DENOTE VALUES WHICH 4302D AND 4303D ARE DIFFERENT.
8. THE FOLLOWING TABLE SPECIFIES THE DIFFERENCE BETWEEN 4302D AND 4303D.

PART	4302D		4303D	
	MASTER	SLAVE	MASTER	SLAVE
R07	5.1k	5.1k	2.7K	2.7K
R25	270	270	330	330
R32	3.3k	3.3k	2.2K	2.2K
R45	NO	1M	NO	1M
D01-04	1N5402	1N5402	TIE 620	TIE 620
Q07	2N3055	2N3055	2N3772	2N3772
C01	2200	2200	3300	3300



DWG No.	82003000		
DESCRIPTION	DIGITAL POWER SUPPLY (4000D) CIRCUIT DIAGRAM		
DRAFTED BY	ANITA YUEN 4/5/1988	FIRST USED	
		4303D	
DESIGNED BY		SHEET	SIZE
APPROVED BY		_OF_	A3

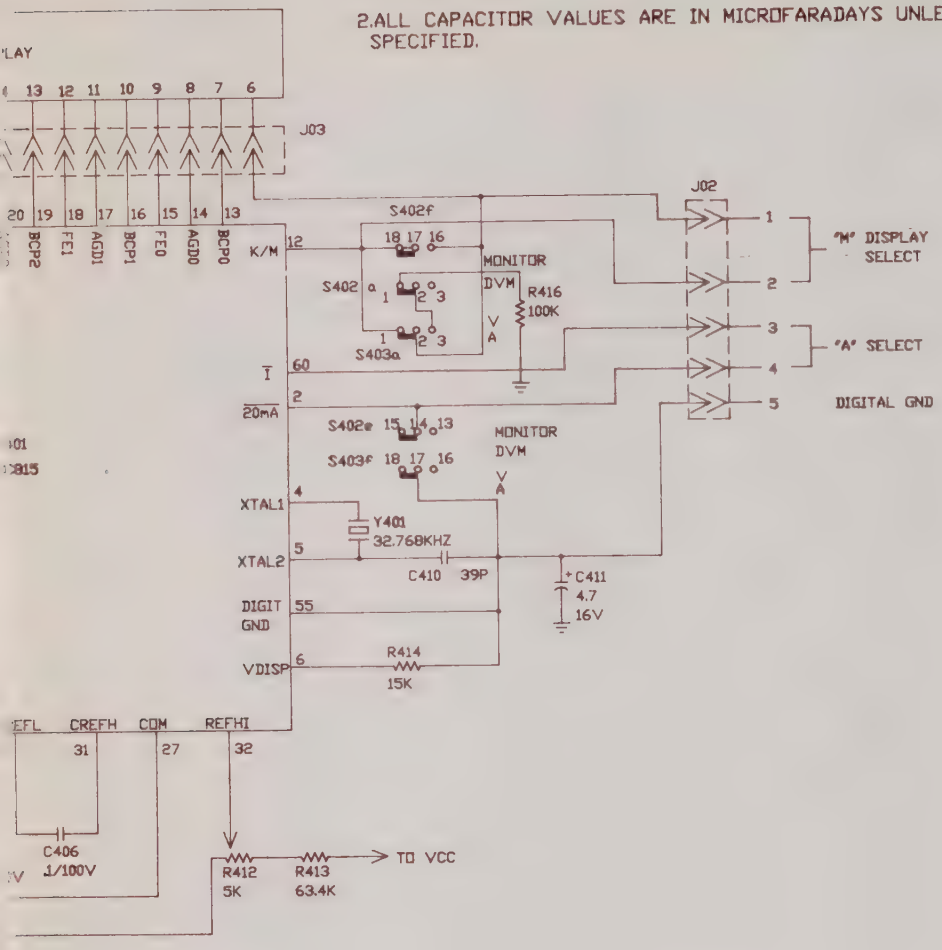



DS401
LCD
J05
S401c
S401b
S401d
S401a
S403e
S402b
S402c
S403d
S403b
S403c
S402d
R401
20
R402
975K 1/2W
R403
100K
R404
50K
R405
111K
R406
10.1K
R407
1K
R408
100
VR1 (÷1)
VR2 (÷10)
VR3 (÷100)
VR4 (÷1000)
VR5 (÷10000)
BP1
BP2
BP3
LO/∧
∩/V
AC/-/AUTO
-MEM/BATT
BCP3
FE2
DVM+
DVM-
MONITOR DVM
J06
ANALOG GND
CASE
VCC
VSS
ANALOG GND
CURRENT IN
VOLT IN
J01
R420
990K
R412
5K
VCC
VSSA
VSSD
RVIBUF
CAZ
CI
CFI
R409
150K
C403
.1/100V
C404
.1/100V
C407
.0022
400V
J04
0V
11V
1A BRIDGE
DB402
78L09
U402
C401
100
16V
C402
10
16V
J01
+9V

NOTES

1.ALL RESISTOR VALUES ARE IN OHM UNLESS OTHERWISE SPECIFIED.
(K-KILOHMS, M-MEGAOHM)

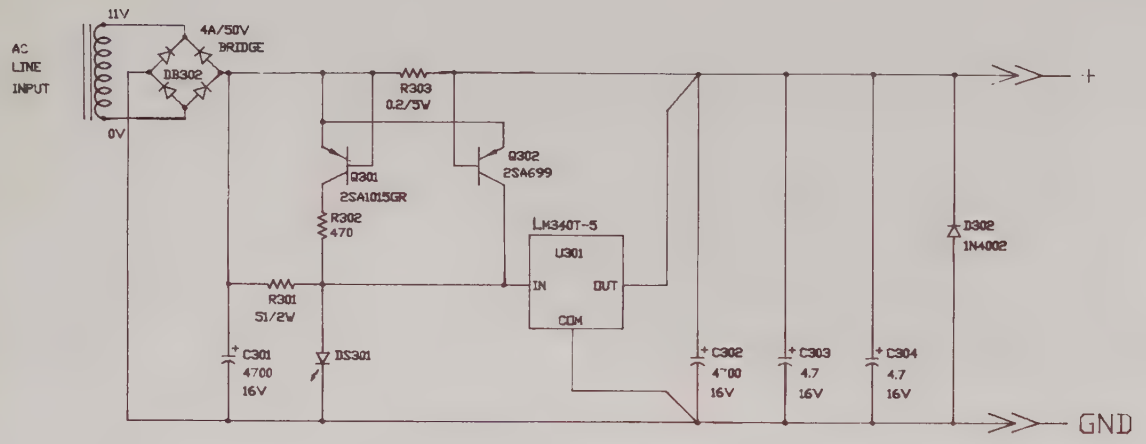
2.ALL CAPACITOR VALUES ARE IN MICROFARADAYS UNLESS OTHERWISE SPECIFIED.



DWG No.	82003001		
DESCRIPTION	DIGITAL POWER SUPPLY (4000D) CIRCUIT DIAGRAM-2		
DRAFTED BY	ANITA YUEN 4/7/1988	FIRST USED	
		4000D	
DESIGNED BY		SHEET	SIZE
APPROVED BY		1 OF 1	A3

NOTES

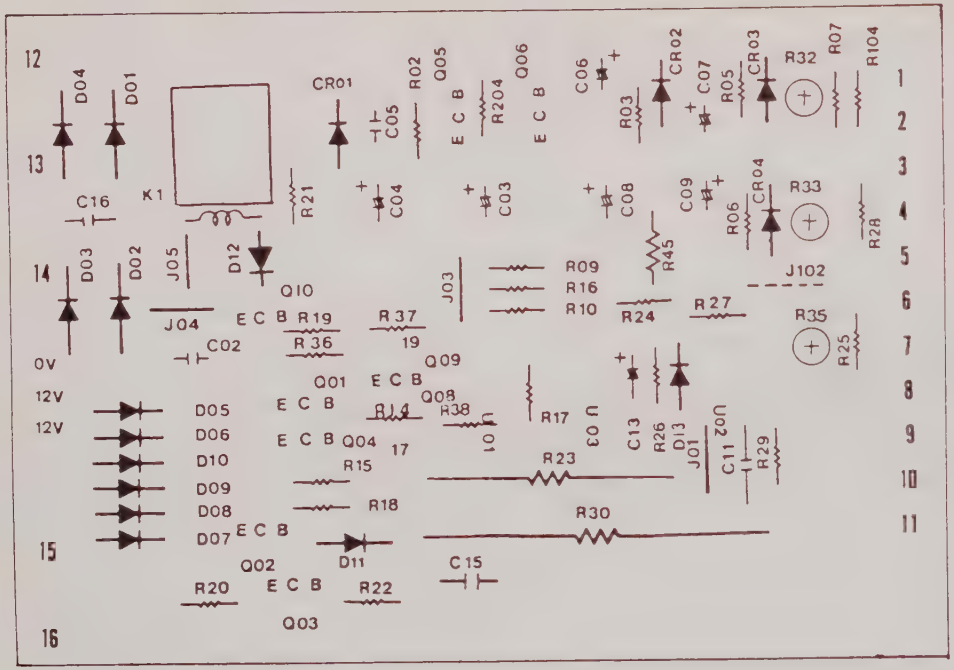
1. ALL RESISTOR VALUES ARE IN OHMS UNLESS OTHERWISE SPECIFIED.
2. ALL CAPACITOR VALUES ARE IN MICROFARDAYS UNLESS OTHERWISE SPECIFIED.



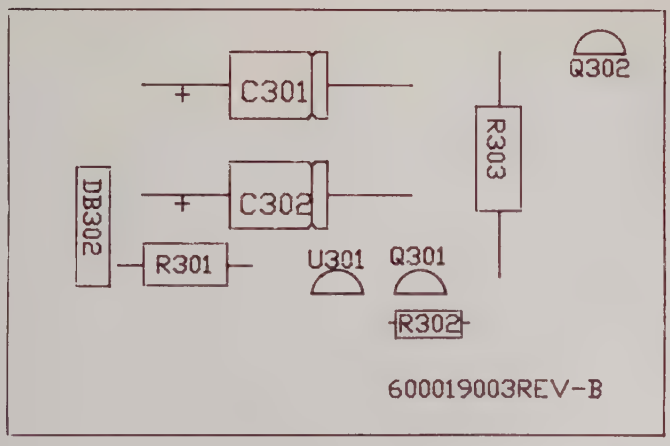
DWG No	82002001
DESCRIPTION	POWER SUPPLY 5V/3A CIRCUIT DIAGRAM
DRAFTED BY	ANITA YUEN 4/6/1988
DESIGNED BY	
APPROVED BY	

FIRST USED	
4303	
SHEET	SIZE
1 OF 1	A4

REVISION	DATE



DO NOT SCALE THIS DRAWING	TOLERANCE UNLESS SPECIFIER ARE ANGLES · DECIMALS	DIGITAL DC POWER SUPPLY COMPONENT LAYOUT
TOPWARD ELECTRIC INSTRUMENTS CO., LTD.		DRAWING NO: 82401001
	DRAFTER Anita Yuen 4.29.88	DESIGNER / APPROVED


C301
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J05
S401
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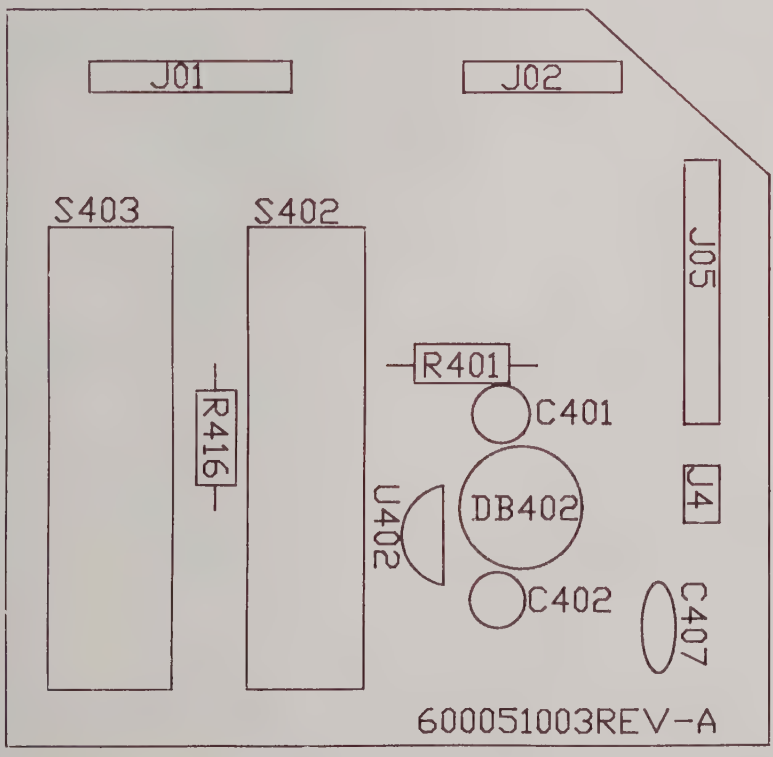
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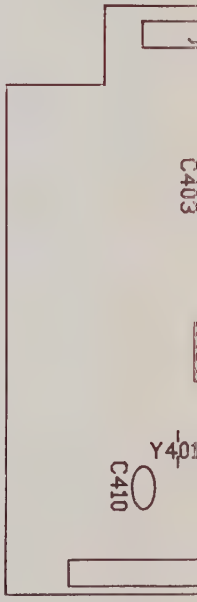
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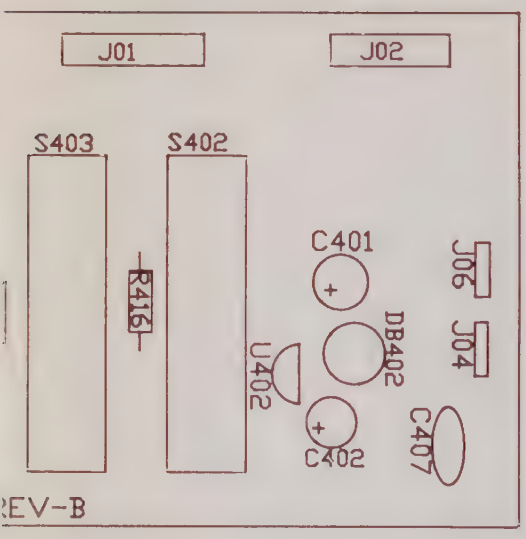
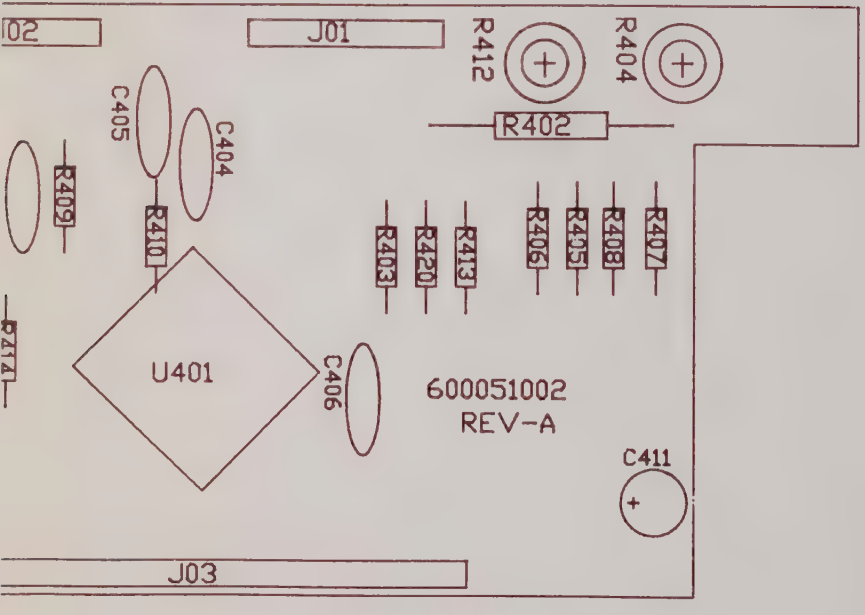
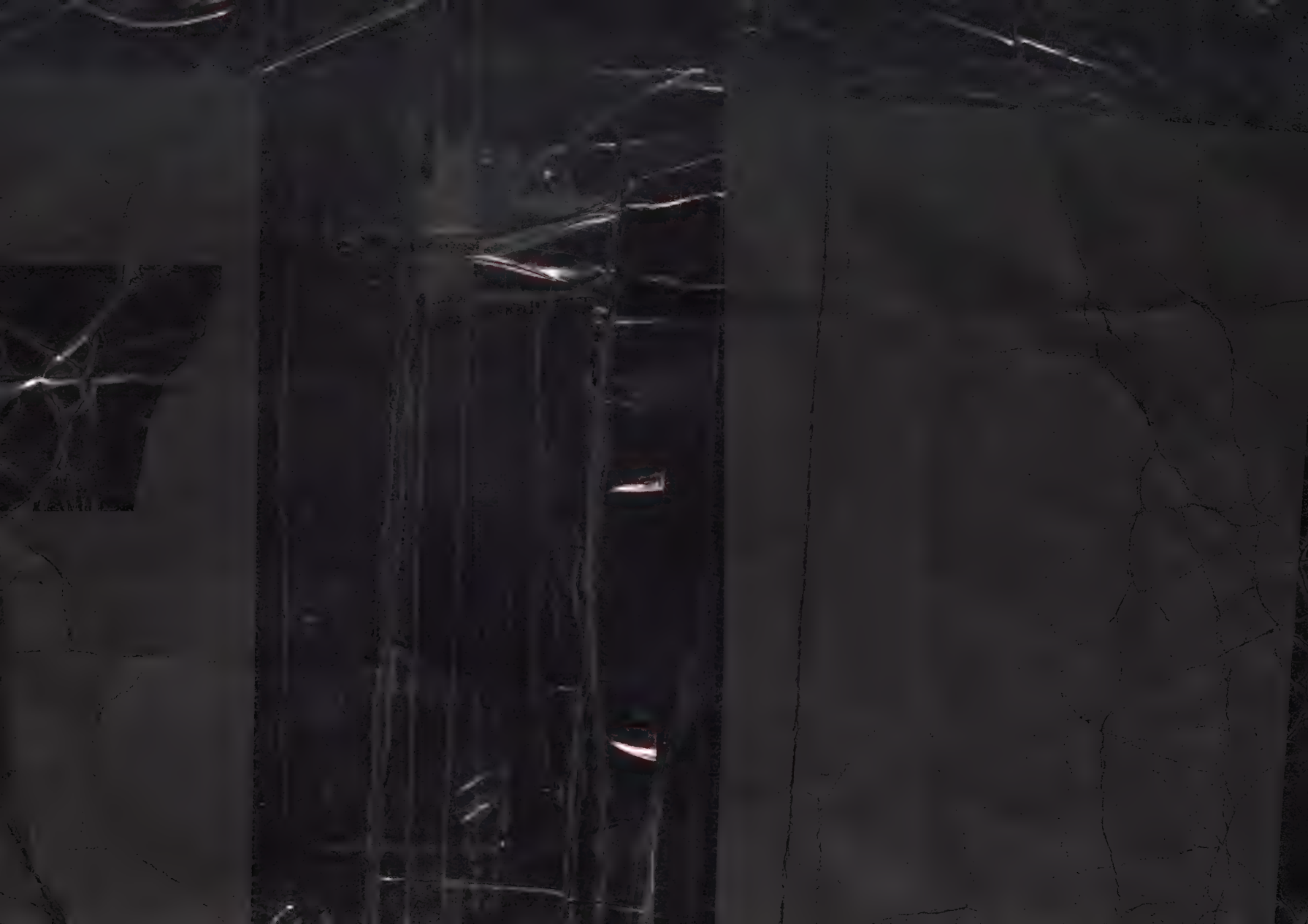


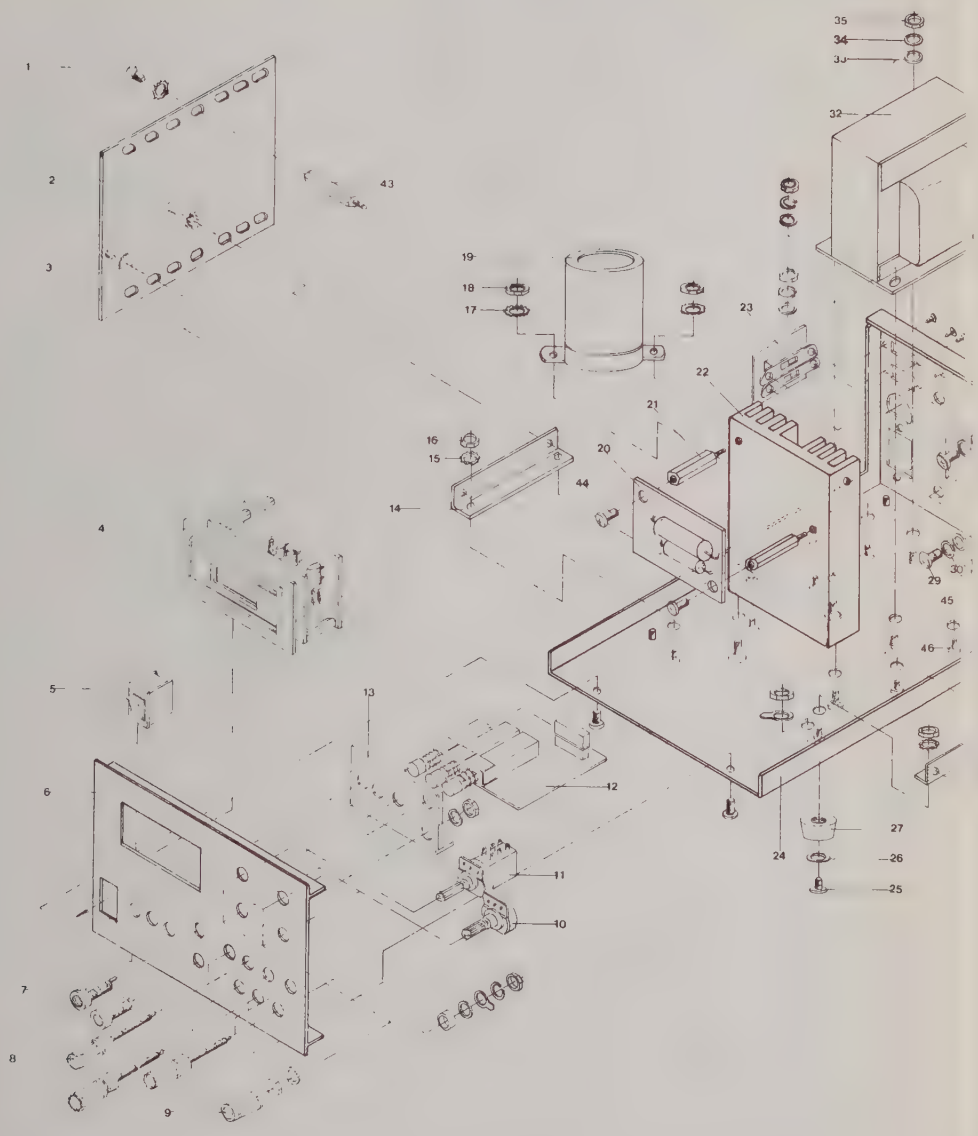


DWG No.	82401000
DESCRIPTION	2000D/4000D SERIES COMPONENT LAYOUT
DRAFTED BY	ANITA YUEN 4/8/1988
DESIGNED BY	
APPROVED BY	

FIRST US

SHEET

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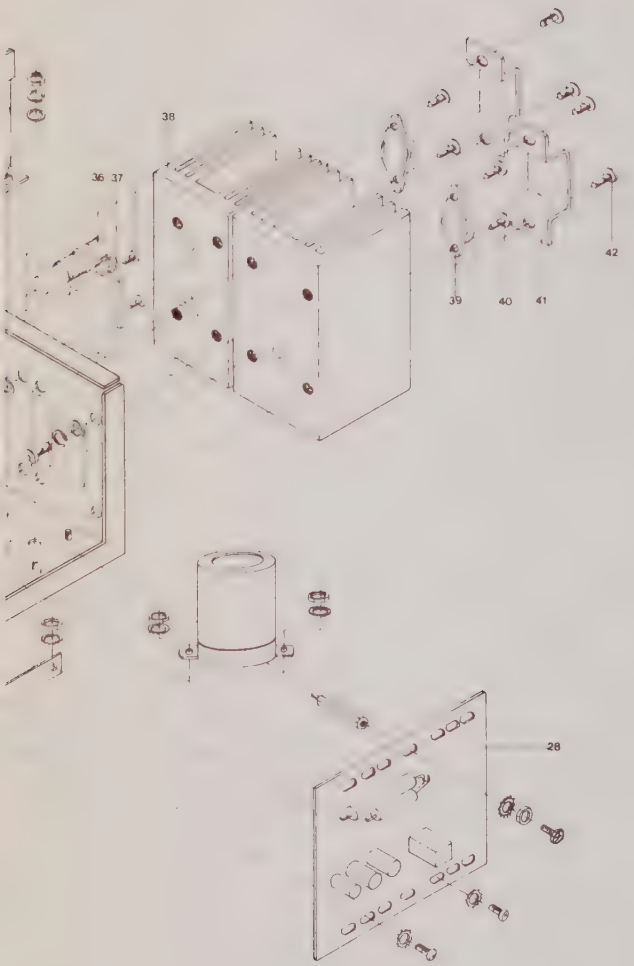
REVISION	DATE



ITEM	DESCRIPTION	QTY
1	SCREW CPS(M3*6)	29
2	PCB	1
3	STOP WASHER	1
4	LCD FRAME	1
5	ROCKER SW	1
6	FRONT PANEL	1
7	TERMINAL	2
8	R1-14	2
9	KNOB	4
10	VR(10KB)	2
11	VR(1KB)	2
12	PCB	1
13	LCD BRACKET	1
14	PCB SEAT	2
15	STOP WASHER	38
16	NUT	38
17	STOP WASHER	38
18	NUT	38
19	ELECTROLYTIC CAPACITOR	2
20	PCB	1
21	STAND OFF	1
22	5V HEAT SINK	1
23	SLIDE SW	1
24	CHASSIS	1
25	SCREW CPS (M3*10)	4
26	WASHER(4D)	4
27	RUBBER PAD	4
29	SCREW CPS (M5*12)	4
30	SPRING WASHER	12
31	WASHER(5D)	12
32	TRANSFORMER	1
33	WASHER(7D)	4
34	SPRING WASHER	6
35	NUT	4
36	FUSE SOCKET	1
37	AC SOCKET	1
38	HEAT SINK	2
39	TRANSISTOR	2
40	SCREW CPS(M4*8)	4
41	TRANSISTOR COVER	2
42	SCTREW CPS(M5*10)	8
43	STAND OFF(M3*5)	1

DO NOT SCALE THIS DRAWING	TOLERANCE UNLESS SPECIFIER ARE ANGLES ± DECIMALS ±	DIGITAL POWER SUPPLY ASSEMBLY DRAWING	
TOPWARD ELECTRIC INSTRUMENTS CO., LTD.	DRAFTER	DRAWING NO: 82503000 DESIGNER	APPROVED

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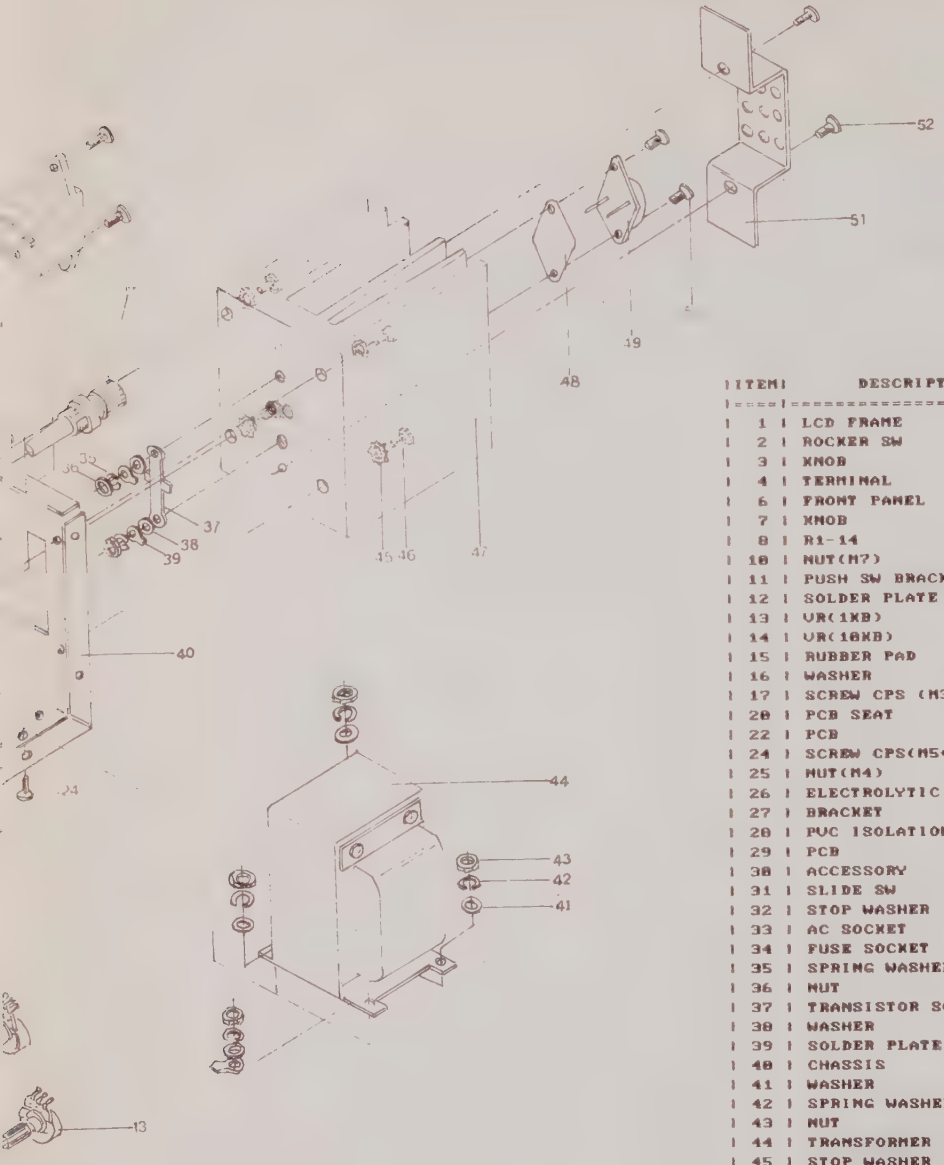
REVISION	DATE



ITEM	DESCRIPTION	QTY
1	LCD FRAME	1
2	ROCKER SW	1
3	KNOB	2
4	TERMINAL	1
6	FRONT PANEL	1
7	KNOB	3
8	R1-14	3
10	NUT(M7)	3
11	PUSH SW BRACKET	1
12	SOLDER PLATE	4
13	VR(1KB)	1
14	VR(10KB)	1
15	RUBBER PAD	4
16	WASHER	4
17	SCREW CPS (M3*6)	20
20	PCB SEAT	1
22	PCB	1
24	SCREW CPS(M5*110)	4
25	NUT(M4)	4
26	ELECTROLYTIC CAPACITOR	1
27	BRACKET	1
28	PVC ISOLATION COVER	1
29	PCB	1
30	ACCESSORY	1
31	SLIDE SW	1
32	STOP WASHER	26
33	AC SOCKET	1
34	FUSE SOCKET	1
35	SPRING WASHER	4
36	NUT	2
37	TRANSISTOR SOCKE'	1
38	WASHER	2
39	SOLDER PLATE	2
40	CHASSIS	1
41	WASHER	4
42	SPRING WASHER	4
43	NUT	17
44	TRANSFORMER	1
45	STOP WASHER	26
46	SCREW CPS (M3*8)	5
47	HEAT SINK	1
48	MICA PLATE	1
49	TRANSISTOR	1
50	SCREW CPS(M4*8)	2
51	TRANSISTOR COVER	1
52	SCREW CPS (M3*10)	4

DO NOT SCALE THIS DRAWING

TOPWARD
ELECTRIC INSTRUMENTS.CO., LTD

TOLERANCE
UNLESS SPECIFIER ARE
ANGLES ±
DECIMALS ±

DIGITAL POWER SUPPLY
ASSEMBLY DRAWING
DRAWING NO: 82501000

DRAFTER
DESIGNER
APPROVED

4/21-11

SPECIFICATIONS

Mode		2303D	2302D	4303D	4302D
Output	DC Voltage DC Current	0 ~ 30V 0 ~ 3A	0 ~ 30V 0 ~ 2A	0 ~ ± 30V 0 ~ ± 3A	0 ~ ± 30V 0 ~ ± 2A
Loading Effect (Load Regulation)	CV CC	0.02% + 5mV 0.02% + 5mA			
Source Effect (line Regulation)	CV CC	0.02% + 2mV 0.02% + 0.25mA			
PARD (Ripple & Noise) At Any Line Voltage	CV CC	0.5mV(rms), 4mV(p-p) 0.5mA(rms), 4mA(p-p)			
Display		3 1/2 LCD display with unit indicator			
Output Voltage Monitor		199.9mV, 1.999V, 19.99V, 199.9V 4 Auto-ranges			
Output Current Monitor		19.99A			
DVM		±199.9mV, ±1.999V, ±19.99V, ±199.9V 4 Auto-ranges			
Accuracy		± (0.2% + 2d)			
Tracking Error		N/A		± (0.2% + 5mV)	
5V/3A Output	Output Voltage Output Current Ripple and Noise Regulation	N/A		5V ± 5% (Fixed) 3A (Max.) < 2 mVrms 0.1% ± 5 mV	
Input 110V/120V/220V/240V ± 10%		1.5A 170W 60HZ	1.1A 120W 60HZ	3.7A 400W 60HZ	2.6A 290W 60HZ
Dimensions: (W, H, D in mm)		125x140x300	125x140x300	210x140x363	210x140x363
Weight : (in Kg)		4	4	8	8
Accessory : ACS-002 (Banana-Clip)		1	1	2	2
Operating Temperature Range		0 C to 40 C in Operating -20 C to 55 C in Storage			

Notes : CV=Constant Voltage, CC=Constant Current
Input voltage can be factory-modified to meet different country.

PARTS LIST

Location	Description
C 001	ELECTROLYTIC CAPACITOR 3300UF 75V +80%~-20%
C 002	ELECTROLYTIC CAPACITOR 470UF 25V +80-20%
C 003	ELECTROLYTIC CAPACITOR 470UF 25V +80-20%
C 004	ELECTROLYTIC CAPACITOR 470UF 25V +80-20%
C 005	ELECTROLYTIC CAPACITOR 220UF 16V +80%~-20%
C 006	ELECTROLYTIC CAPACITOR 10UF 16V +80%~-20%
C 007	ELECTROLYTIC CAPACITOR 10UF 16V +80%~-20%
C 008	ELECTROLYTIC CAPACITOR 1000UF 50V +80% ~ -20%
C 009	ELECTROLYTIC CAPACITOR 220UF 16V +80%~-20%
C 011	MYLAR CAPACITOR 0.22UF 50V 10% (L TYPE)
C 012	ELECTROLYTIC CAPACITOR 200UF 50V +80%~20%
C 013	ELECTROLYTIC CAPACITOR 2.2UF 50V +80-20%
C 015	MYLAR CAPACITOR 0.22UF 50V 10% (L TYPE)
C 016	MYLAR CAPACITOR 0.47UF 100V 10%
C 023	MYLAR CAPACITOR 0.47UF 100V 10%
C 301	ELECTROLYTIC CAPACITOR 4700UF 16V +80%~-20% (AXIAL)
C 302	ELECTROLYTIC CAPACITOR 4700UF 16V +80%~-20% (AXIAL)
C 303	ELECTROLYTIC CAPACITOR 4.7UF 16V +80%~-20%
C 304	ELECTROLYTIC CAPACITOR 4.7UF 16V +80%~-20%
C 401	ELECTROLYTIC CAPACITOR 100UF 16V +80%~-20%
C 402	ELECTROLYTIC CAPACITOR 10UF 16V +80%~-20%
C 403	MYLAR CAPACITOR 0.1UF 100V
C 404	MYLAR CAPACITOR 0.1UF 100V
C 405	MYLAR CAPACITOR 0.01UF 50V 10% (L-TYPE)
C 406	MYLAR CAPACITOR 0.1UF 100V
C 407	MYLAR CAPACITOR 0.0022UF 400V 10%
C 410	NPO CERAMIC CAPACITOR 39P 50V 10%
C 411	ELECTROLYTIC CAPACITOR 4.7UF 16V +80%~-20%
CR001	ZENER DIODE 10V 5% 0.5W
CR002	ZENER DIODE 12V 5% 0.5W
CR003	ZENER DIODE 3.3V 5% 0.5W
CR004	ZENER DIODE 8.2V 5% 0.5W
D 001	DIODE TIE620 6A 150V
D 002	DIODE TIE620 6A 150V
D 003	DIODE TIE620 6A 150V
D 004	DIODE TIE620 6A 150V
D 005	DIODE 1N4002 100V 1A
D 006	DIODE 1N4002 100V 1A
D 007	DIODE 1N4002 100V 1A
D 008	DIODE 1N4002 100V 1A
D 009	DIODE 1N4002 100V 1A
D 010	DIODE 1N4002 100V 1A
D 011	DIODE 1N4148 75V 100mA
D 012	DIODE 1N4002 100V 1A
D 013	DIODE 1N4002 100V 1A
D 014	DIODE 1N4002 100V 1A
D 302	DIODE 1N4002 100V 1A

D 402	DIODE BRIDGE 1A 250V
DB302	DIODE BRIDGE 4A 50V
DS002	LED SQUARE LTL3218A RED
DS003	LED SQUARE LTL3218A RED
DS301	LED CS-0311-4 (RED) 5mm ROUND
DS401	DISPLAY LCD (VIM-2)
F 001	FUSE 5A L=30mm D=6.5mm
K 001	RELAY 12V 5A 2POLES EMI 6 PIN 250VAC
Q 001	TRANSISTOR 2SC1815 GR
Q 002	TRANSISTOR 2SC2270C
Q 003	TRANSISTOR 2SC1815 GR
Q 004	TRANSISTOR 2SA1015 GR
Q 005	TRANSISTOR 2SC1096
Q 006	TRANSISTOR 2SA1015 GR
Q 007	TRANSISTOR 2N3772 TO-3 type
Q 008	TRANSISTOR 2SA1015 GR
Q 010	TRANSISTOR 2SA1015 GR
Q 302	TRANSISTOR 2SA699
Q 310	TRANSISTOR 2SA1015 GR
R 002	CARBON FILM RESISTOR 470 1/4W 5%
R 003	CARBON FILM RESISTOR 470 1/4W 5%
R 004	CARBON FILM RESISTOR 470 1/4W 5%
R 005	CARBON FILM RESISTOR 2K 1/4W 5%
R 006	CARBON FILM RESISTOR 390 1/4W 5%
R 007	CARBON FILM RESISTOR 2.7K 1/4W 5%
R 008	VR 1KB WIRING-TYPE D=16mm NO TEETH
R 009	CARBON FILM RESISTOR 680K 1/4W 5%
R 010	CARBON FILM RESISTOR 100K 1/4W 5%
R 012	VR 10KB WIRING-TYPE D=16mm NO TEETH
R 012	VR 10KB D=16mm NO TEETH 4POLES SW
R 014	CARBON FILM RESISTOR 470 1/4W 5%
R 015	CARBON FILM RESISTOR 470 1/4W 5%
R 016	CARBON FILM RESISTOR 270K 1/4W 5%
R 017	CARBON FILM RESISTOR 300K 1/4W 5%
R 018	CARBON FILM RESISTOR 100 1/4W 5%
R 019	CARBON FILM RESISTOR 2.7K 1/4W 5%
R 020	CARBON FILM RESISTOR 100 1/2W 5%
R 021	CARBON FILM RESISTOR 100 1W 5%
R 022	CARBON FILM RESISTOR 100 1/4W 5%
R 023	WIRE WOUND RESISTOR 0.15 5% 5W (KNP TYPE)
R 024	CARBON FILM RESISTOR 10K 1/4W 5%
R 025	CARBON FILM RESISTOR 330 1/4W 5%
R 026	CARBON FILM RESISTOR 100 1/4W 5%
R 027	CARBON FILM RESISTOR 10K 1/4W 5%
R 028	CARBON FILM RESISTOR 4.7K 1/4W 5%
R 029	CARBON FILM RESISTOR 15K 1/4W 5%
R 030	METAL OXIDE FILM RESISTOR 3K 10% 5W

Location	Description
R 032	SVR 2.2KB CARBON FILM D=10mm (RIVER 10-C)
R 033	SVR 2.2KB CARBON FILM D=10mm (RIVER 10-C)
R 035	SVR 220B CARBON FILM (RIVER 10-C)
R 036	CARBON FILM RESISTOR 470 1/4W 5%
R 038	CARBON FILM RESISTOR 2K 1/4W 5%
R 040	METAL FILM RESISTOR 10K 1/4W 0.25%
R 045	CARBON FILM RESISTOR 1M 1/4W 5%
R 301	METAL OXIDE FILM RESISTOR 51 5% 2W
R 302	CARBON FILM RESISTOR 470 1/4W 5%
R 303	WIRE WOUND RESISTOR 0.2 10% 5W
R 401	CARBON FILM RESISTOR 20 1/4W 5%
R 402	METAL FILM RESISTOR 975K 1% 1/2W
R 403	CARBON FILM RESISTOR 100K 1/4W 5%
R 404	TRIMMER RESISTOR 50K 0.3W 20% 200ppm (NOBLE TM64K 3PV)
R 405	METAL FILM RESISTOR 111K 0.1% 1/4W
R 406	METAL FILM RESISTOR 10.1K 0.1% 1/4W
R 407	METAL FILM RESISTOR 1K 0.1% 1/4W
R 408	METAL FILM RESISTOR 100 0.1% 1/4W
R 409	METAL FILM RESISTOR 150K 1% 1/4W
R 410	CARBON FILM RESISTOR 100K 1/4W 5%
R 412	SVR 5KB 0.3W 20% 200ppm 6CKPH (IS)
R 413	METAL FILM RESISTOR 63.4K 1% 1/4W
R 414	CARBON FILM RESISTOR 15K 1/4W 5%
R 416	CARBON FILM RESISTOR 100K 1/4W 5%
R 420	METAL FILM RESISTOR 990K 1% 1/4W
S 001	ROCKER SW (POWER) RB-66
S 003	SLIDE SWITCH PCB-type 6PIN 5A 125V (ALPHA SS-13T-022-10
S 004	SLIDE SWITCH PCB-type 6PIN 5A 125V (ALPHA SS-13T-022-10
S 401	3 KEY PUSH-SWITCH P=15mm (SPUE 32AA94-OF)
S 402	3 KEY PUSH-SWITCH P=15mm (SPUE 32AA94-OF)
S 403	3 KEY PUSH-SWITCH P=15mm (SPUE 32AA94-OF)
U 001	IC 741 OP-AMP
U 002	IC 741 OP-AMP
U 003	IC 741 OP-AMP
U 301	IC LM340T-5 5V 3% VOLTAGE REFRENCES
U 401	IC TSC815CBQ
U 402	IC 78L09
Y 401	CRYSTAL 32.768KHZ

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